REMARKS

Claims 1 through 5 have been amended and remain pending in the present application. In view of the above amendment, applicant believes the pending application is in condition for allowance.

Thus, prompt and favorable consideration of this amendment is respectfully requested. If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (248) 641-1600.

Applicant believes no fee is due with this response. However, if a fee is due, please charge our Deposit Account No. 08-0750, under Order No. 6340-000071/US/NP from which the undersigned is authorized to draw.

Dated: April 28, 2006

Respectfully submitted,

By _____

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SEALED ROLLING BEARING

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a National Stage of International Application No. PCT/JP2004/015711, filed October 22, 2004, which claims priority to Japanese Patent Application No. 2003-367307, filed October 28, 2003 and Japanese Patent Application No. 2004-004245, filed January 9, 2004. The disclosures of the above applications are incorporated herein by reference.

FIELD

[0002] ~~[0001]~~ The present invention relates to a sealed rolling bearing used ~~for~~in automobiles, motors in general use etc., and, more particularly, to a sealed roller bearing used under circumstances ~~in which~~where a great deal of water, muddy water and many other foreign matter~~s~~ exist.

BACKGROUND

[0003] ~~[0002]~~ In general, sealed roller bearings, ~~having~~with ~~a~~ high sealability, prevent~~ing~~ ingress of rain water or dusts into the inside of the bearing. The bearings are used, for example, as bearings for the suspension of automobiles. This is due to the fact that ~~since~~ these bearings are usually exposed to severe conditions~~circumstances~~ which ~~containing~~contain muddy water, dusts etc. On the other hand, such a rolling bearing is required to have ~~its~~a small rotational torque since a large rotational torque ~~of~~on the bearing causes adverse influence to bearing temperature rise ~~of the bearing~~ and fuel consumption. Since the sliding resistance of the seals is a major factor ~~of~~that influences~~causing~~ an increase ~~of~~in the rotational

torque of the bearing, it ~~has been desired~~is desirous to provide a sealed rolling bearing that has~~having~~ not only a high sealability but a small sliding resistance.

[0004] ~~[0003]~~ One representative example of such a bearing for an automobile ~~will be~~ is described with reference to Fig. 1. Fig. 1 ~~showing~~shows a first embodiment of the present ~~invention~~disclosure. This bearing is ~~that~~ used for a driving wheel of an automobile. The bearing includes ~~and comprises~~ an outer member ~~1~~ integrally formed with a body mounting flange on its outer circumference. ~~with a body mounting flange 2~~ The flange is adapted to be mounted on a body (not shown) of the automobile. The outer member is also ~~and also~~ formed ~~on its inner circumferential surface~~ with double row outer raceway surfaces on its inner circumferential surface. A wheel hub ~~8 and 8; a hub wheel 4~~ has an integrally formed wheel mounting flange on ~~its~~ one of its end to mount ~~with~~ a ~~wheel mounting flange 7 on which a~~ wheel (not shown). One inner raceway surface is ~~mounted and also~~ formed on ~~its~~ the outer circumferential surface of the wheel hub. ~~with one inner raceway surface 9a~~The inner raceway surface is arranged oppositely to one of the double row outer raceway surfaces. A ~~8 and 8 and having a~~ cylindrical portion, ~~14~~ of a smaller diameter, axially ~~extending~~extends from the inner raceway surface. ~~9a and further~~ The cylinder portion includes serrations formed on its inner circumferential surface ~~with a serration 6~~ to transmit ~~for~~ torque. An ~~transmission; and an~~ inner ring ~~5~~ is adapted to be ~~fitted~~ fitted on the cylindrical portion ~~14 and~~and the inner ring includes the other inner raceway surfaces formed on its outer circumferential surface ~~with the other inner raceway surface 9b~~.

[0005] ~~[0004]~~ Double row rolling elements (balls) ~~10~~ are arranged between the double row outer and inner raceway surfaces. The balls are ~~8 and 8; 9a and 9b~~

~~and held~~ freely rollably held by cages ~~11~~. Sealing devices ~~12 and 13~~ are arranged at both ends of the outer member ~~1~~ within an annular space formed by an inner member ~~3~~ (including the ~~hub~~ wheel hub ~~4~~ and the inner ring ~~5~~) and the outer member ~~1~~. The sealing devices ~~to~~ prevent ~~leak~~leakage of grease contained within the bearing as well as ingress of rain water or dusts into the inside of the bearing.

[0006] ~~[0005] As shown in Fig. 2, the~~The sealing device of the ~~12 of~~ inboard side, arranged between the outer member ~~1~~ and the inner ring ~~5~~, ~~comprises~~includes a sealing ring ~~17 including~~with a metal core. The metal core has ~~15 having~~ a substantially L-shaped cross-section and is ~~fitted~~ into the outer member ~~1~~. ~~and a~~A sealing member ~~16~~is integrally adhered, via vulcanized adhesion, ~~on~~onto the metal core ~~15~~. ~~A, and a~~ slinger ~~18~~, having a ~~similarly~~similar ~~a~~ L-shaped cross-section, ~~and~~is ~~fitted~~ onto the inner ring ~~5~~. The sealing member ~~16~~ is made of an elastic material, such as rubber, and has~~comprises~~ three sealing lips, ~~i.e.~~ an outer sealing lip ~~23~~, a middle sealing lip ~~24~~ and an inner sealing lip ~~25~~. The tip edge of the outer sealing lip ~~23~~ is in sliding ~~contacted~~contact with ~~to~~ an inner side of an upstanding portion ~~22~~ of the slinger. ~~The 18 and the~~ tip edges of the middle sealing lip ~~24~~ and the inner sealing lip ~~25~~ are in sliding ~~contacted~~contact with ~~to~~ a cylindrical portion ~~21~~ of the slinger ~~18~~.

[0007] ~~[0006] On the other hand the~~The sealing device ~~13~~, on the outboard side, ~~of outboard side comprises as shown in Fig. 3~~ has an annular metal core ~~26~~ and a sealing member ~~27~~ integrally adhered, via vulcanized adhesion, on the metal core 26. The sealing member ~~27~~ is made of elastic material, such as rubber, and has~~comprises~~ three sealing lips. ~~27a, 27b and 27c and the~~The tip edges of ~~those~~the

three sealing lips ~~27a, 27b and 27c~~ are in ~~directly~~direct sealing ~~contacted~~ contact~~to~~ with the surface of the ~~hub~~ wheel hub4.

[0008] ~~[0008]~~ In ~~those~~the sealing devices ~~12 and 13~~ of the bearing for a wheel of a vehicle of the prior art, the slinger ~~18~~ of the sealing device ~~12~~on the ~~of~~ inboard side has ~~the~~a surface roughness of a sliding surface ~~to~~on which the sealing lips ~~23, 24 and 25~~ sliding contact which is limited to a value at the center line average height (Ra) at 0.3μm or less and to a value at the maximum height (Ry) at 1.2μm or less. Thus, foreign materials cannot easily enter into the inside of the bearing. This is due to the ~~because of~~ difficulty ~~of~~to ~~generation~~generate ~~of~~a small gap at the maximum height portions and damages which would be otherwise caused at rolling contact portions by change ~~of~~in the properties of the grease (see Japanese Laid-open Patent Publication No. 184897/2003).

[0009] ~~[0008]~~ However, in order to limit the surface roughness of a sliding surface to which the sealing lips ~~23, 24 and 25~~ sliding contact to the value at the center line average height (Ra) at 0.3μm or less and to the value at the maximum height (Ry) at 1.2μm or less, it is necessary, previously, to press sheet members having the target surface roughness or to carry out lapping of the surfaces of sheet members after the pressing process ~~thereof~~. In fact, since availability of the plate member with ~~having~~ such a target surface roughness is difficult, it is ~~the~~ state of art~~things~~, in view of its manufacturing cost, to carry out lapping of the surfaces of the sheet members after the pressing process ~~thereof~~.

[0010] ~~[0009]~~ Such a lapping of the surface of the slinger ~~18~~ makes its handling very difficult, increases the number of processing steps, and further causes deformation of the surface of the slinger ~~18~~. Such a deformation of the sliding

surface of the slinger ~~18~~ causes variation of the interference of the sealing member. This reduces ~~and thus reduction of~~ the ~~followability~~following ability of the sealing lips and accordingly reduces the sealing~~sealability~~ of the bearing.

SUMMARY

[0011] ~~[0010]~~ It is, therefore, an object of the present disclosure~~invention~~ to provide a sealed rolling bearing ~~provided~~ with sealing devices which provide~~having~~ both functions of high sealability and small sliding resistance, which are antipodal to each other.

[0012] ~~[0011] For achieving~~ To achieve the object mentioned above, ~~there is provided, according to the present invention of claim 1,~~ a sealed rolling bearing ~~comprising~~comprises an outer member with outer raceway surfaces formed on its inner circumferential surface. An ~~with outer raceway surface; an~~ inner member is formed with inner raceway surfaces ~~formed~~ on its outer circumferential surface. The ~~with~~ inner raceway surface is arranged ~~oppositely~~opposite to the outer raceway surface. Rolling~~; rolling~~ elements are ~~contained~~ freely rollably contained between the outer and inner raceway surfaces. ~~; and sealing~~Sealing devices are arranged in an annular space formed between the outer and inner members. ~~characterized in that each~~Each of the sealing devices has sealing lips formed from an ~~of~~ elastic member. ~~; that the~~The maximum height Ry or Rmax of the surface roughness of a sliding surface of a member of the rotational side ~~to~~ which the sealing lips sliding contact is limited to a value ~~at~~of 2.0μm or less. The~~, and that the~~ run-out of the sliding surface, normal thereto, is limited to a value ~~at~~of 30μm or less.

[0013] ~~[0012] According to the present invention of claim 1, since~~Since each of the sealing devices has sealing lips formed from an ~~of~~ elastic member and ~~; that~~

the maximum height Ry or Rmax of the surface roughness of ~~a~~ the sliding surface of a member of the rotational side ~~to~~ which the sealing lips sliding contact is limited to a value of~~at~~ 2.0μm or less, and ~~that~~ the run-out of the sliding surface normal thereto is limited to a value ~~at~~of 30μm or less, it is possible to suppress the absolute irregularities of the sliding surface to a small ~~as well as~~ variation. Also, it is possible to suppress variation of the interference without increasing the interference of the sealing member. This ~~and thus to avoid~~ avoids the problem of deformation of the sliding surface which is caused by the lapping of the slinger. Accordingly, it is possible to stabilize the ~~followability~~following ability of the sealing lips relative to the sliding surface and thus further ~~to~~ improve the sealability.

[0014] ~~[0013]~~ It is preferable~~, as defined in claim 2,~~ that the sealing device ~~comprises~~includes a sealing ring mounted on a member of the stationary side and a slinger mounted on a member of the rotational side. The ~~, and that the~~ sealing lips, forming the sealing ring, are in sliding ~~contacted~~contact with ~~to~~ the slinger. This structure makes it unnecessary to strictly restrict the target surface roughness by applying a lapping process to the sliding surface after the pressing process. Thus, it ~~and it~~ is possible to improve the sealability ~~only~~ by only setting the run-out of the sliding surface at a predetermined value.

[0015] ~~[0014]~~ Also, ~~it is preferable, as defined in claim 3,~~ the sealing device includes ~~comprises~~ a sealing ring mounted on a member of the stationary side, ~~and including~~ side lips and a radial lip. The~~, and that the~~ sealing lips are in ~~directly~~direct sliding ~~contacted~~contact with ~~to~~ the member of the rotational side. This structure makes it possible to easily carry out ~~the~~ surface machining, such as grinding or

lapping, of the sliding surface after heat treatment ~~thereof~~ even if the target surface roughness and the run-out are ~~would~~ not ~~be~~ obtained.

[0016] ~~[0015]~~ Further, ~~it is preferable, as defined in claim 4, that~~ the sealing device includes ~~comprises~~ a sealing ring mounted on a member of the stationary side, ~~and including~~ a main lip and a sub lip~~,~~. The ~~that the~~ main lip is in ~~directly~~direct sliding ~~contacted~~contact with ~~to~~ a sealing groove formed on a member of the rotational side. ~~and having~~The sealing groove has a substantially U-shaped cross-section~~,~~. ~~and that the~~ The sub lip is in sliding ~~contacted~~contact with ~~to~~ a ridge of the sealing groove, via a small interference. This structure makes it possible to increase the interference, ~~with~~while keeping the ~~sealability~~sealing ability, due to ~~ability of~~ the following ability of the sub lip when the main lip wears. Accordingly, it is possible to suppress the rotational torque of the bearing during a small amount of wear of the main lip ~~is kept small~~ as well as to obtain the ~~sealability~~ sealing ability due to an increase of interference in accordance with the wear of the main lip.

[0017] ~~[0016] It is also preferable, as defined in claim 5, that~~ Also, preferably the maximum height Ry or Rmax of the surface roughness of the sliding surface is limited to a value ~~of~~at 1.2μm or less. The~~, and the~~ run-out of the sliding surface, normal thereto, is limited to a value ~~at~~of 10μm or less. This ~~enables to provide~~provides a sealed rolling bearing ~~provided~~ with sealing devices which has ~~having~~ both functions of high ~~sealability~~ sealing ability and small sliding resistance, which are ~~antipodal~~opposite to each other.

[0018] ~~[0017] According to the present invention, the~~The sealed rolling bearing ~~comprises~~includes an outer member formed with outer raceway surface on its inner circumferential surface with outer raceway surface. An~~; an~~ inner member is

formed with an inner raceway surface on its outer circumferential surface. The inner raceway surface ~~is with inner raceway surface~~ arranged ~~oppositely~~ opposite to the outer raceway surface. ~~Rolling; rolling~~ elements are ~~contained~~ freely rollably contained between the outer and inner raceway surfaces~~;~~ ~~and~~ Sealing~~sealing~~ devices are arranged in an annular space formed between the outer and inner members. Each ~~and is characterized in that each~~ of the sealing devices has ~~sealing lips of~~ elastic member sealing lips. The~~; that the~~ maximum height Ry or Rmax of the surface roughness of a sliding surface of a member ~~of~~on the rotational side, ~~to~~ which the sealing lips sliding contact, is limited to a value ~~at~~of 2.0μm or less. The~~, and that the~~ run-out of the sliding surface, normal thereto, is limited to a value ~~at~~ of 30μm or less. This makes it possible to suppress the absolute irregularities of the sliding surface to a small variation as well as to suppress variation of the interference without increasing the interference of the sealing member. Thus, this~~ and thus~~ avoids~~to avoid~~ the problem of deformation of the sliding surface which is caused by ~~the~~ lapping of the slinger. Accordingly, it is possible to stabilize the ~~followability~~following ability of the sealing lips relative to the sliding surface and ~~thus~~to further ~~to~~ improve its~~the sealability~~sealing ability.

[0019] ~~[0018]~~ A~~The best mode for carrying out the present invention is a~~ sealed rolling bearing includes~~comprising~~ an outer member with outer raceway surface formed on its inner circumferential surface ~~with outer raceway surface~~; an inner member formed with inner raceway surface on its outer circumferential surface ~~with inner raceway surface~~ arranged ~~oppositely~~ opposite to the outer raceway surface; rolling elements ~~contained~~ freely rollably contained between the outer and inner raceway surfaces; and sealing devices arranged in an annular space formed

between the outer and inner members. Each ~~characterized in that each~~ of the sealing devices has elastic member sealing lips. The ~~of elastic member; that the~~ maximum height Ry or Rmax of the surface roughness of a sliding surface of a member of the rotational side, ~~to~~ which the sealing lips sliding contact, is limited to a value of ~~at~~ 2.0μm or less. The~~, and that the~~ run-out of the sliding surface, normal thereto is limited to a value ~~at~~of 30μm or less.

[0020] ~~[0019]~~ Further areas of applicability will become apparent from the description provided herein. It should be understood that the description and specific examples are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

DRAWINGS

[0021] ~~[0029]~~ Additional advantages and features of the present ~~invention~~disclosure will become apparent from the subsequent description and the appended claims, taken in conjunction with the accompanying drawings, wherein:

[0022] ~~[0021]~~ Fig. 1 is a longitudinal-section view of a first embodiment of a sealed rolling bearing according to a first embodiment. ~~of the present invention;~~

[0023] ~~[0022]~~ Fig. 2 is a partially enlarged sectional view of the sealing device of the inboard side of the sealed rolling bearing according to the first embodiment ~~of the present invention;~~.

[0024] ~~[0023]~~ Fig. 3 is a partially enlarged sectional view of the sealing device of the outboard side of the sealed rolling bearing according to the first embodiment ~~of the present invention;~~.

[0025] ~~[0024]~~ Fig. 4 is a longitudinal-section view of a sealed rolling bearing according to a second embodiment ~~of the present invention;~~.

[0026] ~~[0025]~~ Fig. 5 is a partially enlarged sectional view of a sealing device of a second embodiment~~ of the present invention; and~~.

[0027] ~~[0026]~~ Fig. 6 is a graph showing results of mass variation in a muddy water proof test carried out by exposing a naked bearing, itself, to the muddy water.

DETAILED DESCRIPTION

[0028] ~~[0027]~~ Preferred embodiments of the present invention will be described with reference to accompanied drawings.

[0029] ~~[0028]~~ Fig. 1 is a longitudinal-section view of a first embodiment of a sealed roller bearing~~ of the present invention~~. The sealed rolling bearing shown in Fig. 1 is an example applied to a driving wheel of a vehicle for rotatably supporting the wheel in a suspension of the vehicle. Since the fundamental structure of the bearing provided with the sealing devices previously mentioned has been described at the beginning of this specification using ~~this~~ Fig. 1, characteristic portions of the bearing will be mainly described hereinafter.

[0030] ~~[0029]~~ Sealing devices 12 and 13 are ~~Arranged~~ arranged at either ends of an annular space formed between the outer member 1 and inner member 3, comprised of~~ comprising~~ the ~~hub~~ wheel hub 4 and the inner ring 5 ~~and~~which form ~~forming~~ a member of the rotational side. The~~ and the~~ outer member 1 ~~forming~~forms a member of the stationary side. The~~ are the~~ sealing devices 12 and 13 ~~for preventing~~ prevent leakage of grease contained within the bearing as well as ingress of rain water or dusts into the inside of the bearing.

[0031] ~~[0030]~~ The sealing device 12 ~~mounted~~ mounts between the outer member 1 and the inner wheel 5 ~~at~~on the inboard side (the right hand side in Fig. 1). The sealing device 12 ~~comprises~~, as shown in Fig. 2, includes a sealing ring 17 with~~including~~ a metal core 15. The metal core 15 has ~~having~~ a substantially L-shaped cross-section. The sealing device 12 is ~~and~~ fitted into the outer member 1. A ~~and a~~ sealing member 16 is integrally adhered, via vulcanized adhesion, ~~on~~onto the metal core 15. A, ~~and a~~ slinger 18, with a similar ~~having similarly a~~ L-shaped cross-section, is fit ~~and fitted~~ onto the inner ring 5. The slinger 18 and the metal core 15 are made by press forming of austenitic stainless steel sheet (JIS SUS 304 etc.) or preserved cold rolled sheet (JIS SPCC etc.).

[0032] ~~[0031]~~ The sealing member 16 is made of an elastic material such as rubber and includes~~e~~ ~~emprises~~ three sealing lips, ~~i.e.~~ an outer sealing lip 23, a middle sealing lip 24 and an inner sealing lip 25. The tip edge of the outer sealing lip 23 ~~is~~ sliding ~~contacted~~contacts ~~to~~ an inner side of an upstanding portion 22 of the slinger 18. The ~~and the~~ tip edges of the middle sealing lip 24 and the inner sealing lip 25 are in sliding ~~contacted~~contact with ~~to a~~ cylindrical portion 21 of the slinger 18. The surface roughness of a sliding surface of the slinger 18, ~~to~~ which the sealing lips 23, 24 and 25 are in sliding contact with, is limited to a value ~~at~~of 2.0μm or less, and preferably at 1.2μm or less at the maximum height Ry or Rmax. The, ~~and the~~ run-out of the sliding surface, normal thereto, is limited to a value ~~at~~of 30μm or less, and preferably at 10μm or less. ~~That is~~Accordingly, it is unnecessary to strictly restrict the target surface roughness by applying a lapping process to the sliding surface after the pressing process as in the prior art. This ~~and this~~ is achieved only by setting the run-out of the sliding surface at a predetermined value.

[0033] ~~[0032]~~ Thus, it is possible to suppress the absolute irregularities of the sliding surface to a small variation as well as to suppress variation of the interference without increasing the interference of the sealing member. Thus, this avoids ~~and thus to avoid~~ the problem of deformation of the sliding surface of the slinger 18 which is caused by ~~the~~ lapping the ~~of the~~ slinger as in the prior art. Accordingly, it is possible to stabilize the ~~followability~~following ability of the sealing lips 23, 24 and 25 relative to the sliding surface and to~~thus~~ further ~~to~~ improve the sealability.

[0034] ~~[0033]~~ ~~On the other hand the~~ The sealing device 13 on the~~of~~ outboard side, ~~comprises~~ as shown in Fig. 3, includes an annular metal core 26 and a sealing member 27 integrally adhered, via vulcanized adhesion, on the metal core 26. The metal core 26 is formed~~made~~ by press forming of austenitic stainless steel sheet (JIS SUS 303 etc.) or preserved cold rolled sheet (JIS SPCC etc.). The sealing member 27 is made of an elastic material, such as rubber, and includes ~~comprises~~ two side lips (dust seal) 27a, 27b and one radial lip (grease seal) 27c. The~~, and the~~ tip edges of the sealing lips 27a~~~~27c are in ~~directly~~direct sliding ~~contacted~~contact with ~~to~~ the surface of the ~~hub~~ wheel hub 4. The tip edges contact~~, that is,~~ a sliding surface 19 on the base of the wheel mounting flange 7 ~~at~~on the inboard side.

[0035] ~~[0034]~~ The maximum height Ry or Rmax of the surface roughness of the~~a~~ sliding surface 19, ~~to~~ which slidingly contacts the sealing lips 27a, 27b and 27c, ~~sliding contact~~ is limited to a value ~~at~~of 2.0μm or less, and preferably at 1.2μm or less. The ~~and that the~~ run-out of the sliding surface 19, normal thereto, is limited to a value ~~at~~of 30μm or less, and preferably at 10μm or less. If these target surface roughness or run-out cannot be obtained, a grinding or lapping process may be ~~applied to~~conducted on the sliding surface after ~~its~~it is heat ~~treatment~~treated.

[0036] ~~[0035]~~ Thus, ~~similarly~~similar to the sealing device 12, it is possible to suppress the absolute irregularities of the sliding surface 19 to a small variation as well as to suppress variation of the interference without increasing the interference of the sealing member. This avoids ~~and thus to avoid~~ the problem of deformation of the sliding surface. Accordingly, it is possible to stabilize the ~~followability~~following ability of the sealing lips 27a, 27b and 27c relative to the sliding surface19 and to~~thus~~ further ~~to~~ improve ~~the~~its ~~sealability~~sealing ability.

[0037] ~~[0036]~~ Fig. 4 is a longitudinal-section view of a sealed rolling bearing according to a second embodiment of the present ~~invention~~disclosure. ~~and~~ Fig. 5 is a partially enlarged sectional view of Fig. 4. The sealed rolling bearing 20, exemplary shown in Fig. 4, is a deep groove ball bearing. An ~~and comprises an~~ outer ring 30 is formed with an outer raceway surface 29 on its inner circumferential surface. An ~~with an outer raceway surface~~ ~~29, an~~ inner ring 32 is formed with an inner raceway surface 31 on its outer circumferential surface. Balls ~~with an inner raceway surface 31, balls~~ 34 are contained and ~~held~~ freely rollably held by a cage 33 between the outer and inner raceway surfaces 29 and 31. A, ~~and a~~ pair of sealing rings 35 are arranged in an annular space formed between the outer and inner rings 30 and 32.

[0038] ~~[0037]~~ Each of the sealing ~~ring~~rings 35 has ~~comprises~~ a metal core 36 with~~of~~ flat annular configuration formed ~~of~~from cold rolled steel sheet (JIS SPCC etc.) by press forming. A ~~and a~~ sealing member 37 is integrally adhered, via vulcanized adhesion, ~~on~~onto the metal core 36. The sealing rings 35 are ~~fitted into~~fit into the inner circumferential surface at both ends of the outer ring 30, via the sealing members 37. Each of the sealing ~~member~~members 37 is in direct ~~directly~~ sliding ~~contacted~~contact with a ~~to a~~ sealing groove 38. The sealing groove 38 has ~~having~~ a

substantially U-shaped cross-section formed at each end on the outer circumferential surface of the inner ring~~ at each end thereof~~. A~~More in detail the a~~ main lip 37a of the sealing member 37 contacts an inclined sliding surface 39 of the sealing groove 38. A ~~and a~~ sub lip 37b of the sealing member 37 ~~a~~ contacts a ridge 40 of the sealing groove 38, via a small interface ~~therebetween~~. The base of the sub lip 37b has a constricted cross-section. Thus, ~~and thus~~ the sub lip 37b has a small flexural rigidity. Accordingly, the sub lip 37b can follow the motion of the main lip 37a and move toward the left hand direction (Fig. 5) in accordance with the wear of the main lip 37a. Thus, this increases ~~and thus increase~~ the interference relative to the ridge 40. ~~Thus the~~The sub lip 37b can suppress the rotational torque of the bearing during ~~the~~a small wearing amount ~~of wear~~ of the main lip 37a ~~is small~~ and can ~~on the other hand~~ ensure its ~~sealability~~ sealing ability while~~with~~ increasing the interference relative to the ridge 40 in accordance with wear of the main lip 37a.

[0039] ~~[0038]~~ The maximum height Ry or Rmax of the surface roughness of ~~a~~ at least the sliding surface 39 of the sealing groove 38, ~~to~~ which the main sealing lip 37a ~~sliding~~slidingly contacts, is limited to a value ~~at~~of 2.0μm or less, and preferably at 1.2μm or less. The~~, and that the~~ run-out of the sliding surface 39, normal thereto, is limited to a value ~~at~~of 30μm or less, and preferably at 10μm or less. If these target surface roughness or run-out cannot be obtained, a grinding or lapping process may be conducted on~~applied to~~ the sliding surface after ~~its~~it is heat ~~treatment~~treated.

[0040] ~~[0039]~~ Thus, it is possible to suppress the absolute irregularities of the sliding surface 39 to a small variation as well as to suppress variation of the interference without increasing the interference of the sealing member. Thus, this stabilizes ~~and thus to stabilize~~ the ~~followability~~following ability of the sealing lip 37a

relative to the sliding surface 39 and ~~thus~~ further ~~to improve~~improves its ~~the~~ sealing ability~~sealability~~.

[0041] ~~[0040]~~ Fig. 6 is a graph showing results of mass variation ~~of muddy water~~ in a muddy water proof test carried out by exposing a naked bearing, itself, to the muddy water. This test was carried out by spraying Kanto ~~loam~~ foam JIS 8 mixed liquor onto samples of sealed rolling bearings of the present disclosure~~invention during the driving~~ and the prior art during driving, and then ~~by~~ measuring the mass variation before and after the test. As can be seen from Fig. 6, there are remarkable differences ~~among a~~between sample 1 (Comparative example) having the maximum height Ry or Rmax of 2.02~3.7μm and the run-out of 30μm normal to the sliding surface 39, ~~a~~ sample 2 (Embodiment A) having the maximum height Ry or Rmax of 1.3~1.86μm and the run-out of 10~30μm normal to the sliding surface 39, and ~~a~~ sample 3 (Embodiment B) having the maximum height Ry or Rmax of 0.7~1.2μm and the run-out of 10μm or less normal to the sliding surface 39.

[0042] ~~[0041]~~ The sealed rolling bearing of the present ~~invention~~disclosure can be applied to any type of sealed rolling bearings, irrespective of its bearing or sealing type, used under circumstances ~~in which~~ where a large amount of foreign matter, such as water or muddy water, exists.

[0043] ~~[0042]~~ The present disclosure~~invention~~ has been described with reference to the preferred embodiment. Obviously, modifications and alternations will occur to those of ordinary skill in the art upon reading and understanding the preceding detailed description. It is intended that the present invention be construed to~~as~~ ~~including~~include all such alternations and modifications insofar as they come within the scope of the appended claims or ~~the~~their equivalents ~~thereof~~.

CLAIMS

What is claimed is:

1. A sealed rolling bearing comprising:

_____-an outer member ~~(1; 30)~~ formed with at least one outer raceway surface on its inner circumferential surface;

_____~~with outer raceway surface (8; 29);~~ an inner member ~~(4, 5; 32)~~ formed with at least one inner raceway surface on its outer circumferential surface, said inner raceway surface with inner raceway surface ~~(9a, 9b; 31)~~ arranged oppositeoppositely to the outer raceway surface;

_____~~(8; 29);~~ rolling elements ~~(10; 34) contained~~ freely rollably contained between the outer and inner raceway surfaces; and

_____-sealing devices ~~(12, 13; 35)~~ arranged in an annular space formed between the outer and inner members, ~~(1; 30 and 4,5; 32) characterized in that:~~

_____each of the sealing devices ~~(12, 13; 35)~~ has sealing lips ~~(27a~27c, 23~25; 37a, 37b)~~ of an elastic member, ~~that~~ the maximum height Ry or Rmax of the surface roughness of a sliding surface of a member of a rotational side, ~~(18, 4; 32) to~~ which the sealing lips ~~(27a~27c, 23~25; 37a, 37b)~~ sliding contact, is limited to a value ~~at~~of 2.0μm or less, and ~~that~~ the run-out of the sliding surface, normal thereto, is limited to a value of~~at~~ 30μm or less.

2. ~~A~~ The sealed rolling bearing of claim 1 wherein the sealing device includes ~~(12) comprises a~~a sealing ring ~~(17 or 15, 16)~~ mounted on a member ~~(1)~~ of a stationary side and a slinger ~~(18)~~ mounted on a member ~~(5)~~ of a rotational side, and

~~wherein~~ the sealing lips ~~(23~25)~~ forming the sealing ring ~~(17 or 15, 16) are~~ sliding contact~~contacted to~~ the slinger ~~(18)~~.

3. The~~A~~ sealed rolling bearing of claim 1 wherein the sealing device ~~(13)~~ includes~~comprises~~ a sealing ring, ~~(26, 27)~~ mounted on a member of a stationary side, with~~and including~~ side lips ~~(27a, 27b)~~ and a radial lip ~~(27c)~~, ~~and wherein~~ the sealing lips ~~(27a~27c) are~~directly slidingly ~~dir~~ contacts~~ectly sliding contacted to~~ the member of a rotational side.

4. The~~A~~ sealed rolling bearing of claim 1 wherein the sealing device includes~~comprises~~ a sealing ring ~~(35)~~, mounted on a member of a stationary side, with ~~(30) and including~~ a main lip ~~(37a)~~ and a sub lip ~~(37b)~~, ~~wherein~~ the main lip ~~(37a) is~~ directly sliding ~~contacted~~contacts ~~to~~ a sealing groove ~~(38)~~ formed on a member of a rotational side, said sealing groove ~~(32) and~~ having a substantially U-shaped cross-section, and ~~wherein~~ the sub lip ~~(37a) is~~ slidingly ~~contacted~~contacts ~~to~~ a ridge ~~(40)~~ of the sealing groove ~~(38)~~ via a small interference.

5. The~~A~~ sealed rolling bearing of ~~any one of~~ claim~~s~~ 1~~4~~ wherein the maximum height Ry or Rmax of the surface roughness of the sliding surface is limited to a value ~~at~~of 1.2μm or less, and the run-out of the sliding surface, normal thereto, is limited to a value of~~at~~ 10μm or less.

ABSTRACT

~~An object of the present invention is to provide a~~A sealed rolling bearing has~~provided with~~ sealing devices with ~~having~~ both the functions of high ~~sealability~~sealing ability and small sliding resistance, which are antipodal to each other. ~~According to the present invention, there is provided, a~~The sealed rolling bearing has~~comprising~~ an outer member (1, 30) formed with an outer raceway surface (8, 29) on its inner circumferential surface. An ~~with outer raceway surface (8; 29); an~~ inner member (4, 5, 32~~4, 5; 32~~) is formed with an inner raceway surface (9a, 9b, 31) on its outer circumferential surface. The inner raceway surface (9a, 9b, 31) is ~~with inner raceway surface (9a, 9b; 31)~~ arranged ~~oppositely~~opposite to the outer raceway surface (8, 29~~8; 29~~). Rolling~~; rolling~~ elements (10, 34) are~~contained~~ freely rollably contained between the outer and inner raceway surfaces. Sealing~~; and sealing~~ devices (12, 13, 35) are arranged in an annular space formed between the outer and inner members (1, 30~~1; 30~~ and 4, 5, 32~~4,5; 32~~). Each ~~characterized in that: each~~ of the sealing devices (12, 13; 35) has elastic sealing lips (27a~~~~27c, 23~~~~25, 37a, 37b). The ~~of elastic member; that the~~ maximum height Ry or Rmax of the surface roughness of a sliding surface of a member of the rotational side (18, 4, 32~~18, 4; 32~~), ~~to~~ which the sealing lips (27a~~~~27c, 23~~~~25, 37a, 37b) ~~slidingslidingly~~ contact, is limited to a value ~~at~~of 2.0μm or less. The~~, and that the~~ run-out of the sliding surface, normal thereto, is limited to a value of~~at~~ 30μm or less.